from the confluence of the Illinois River. Photo 7-85 shows an upstream view of this site, and Photo 7-86 shows exposed tree roots. Three bank sections taken are shown in figures 7-115 through 7-117. The bank soils are fine silt (FST) to coarse clay (CC).

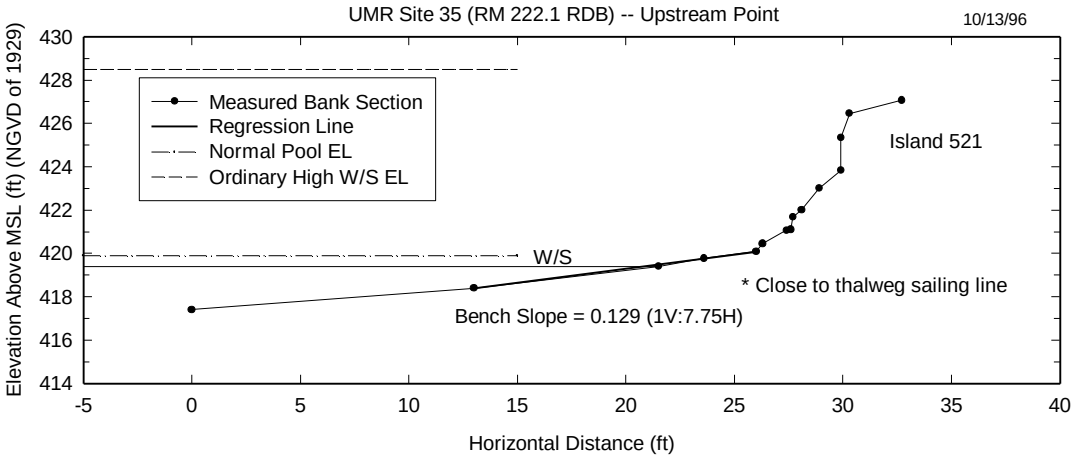

Figure 7-115 Bank section measured at Site 35 upstream point

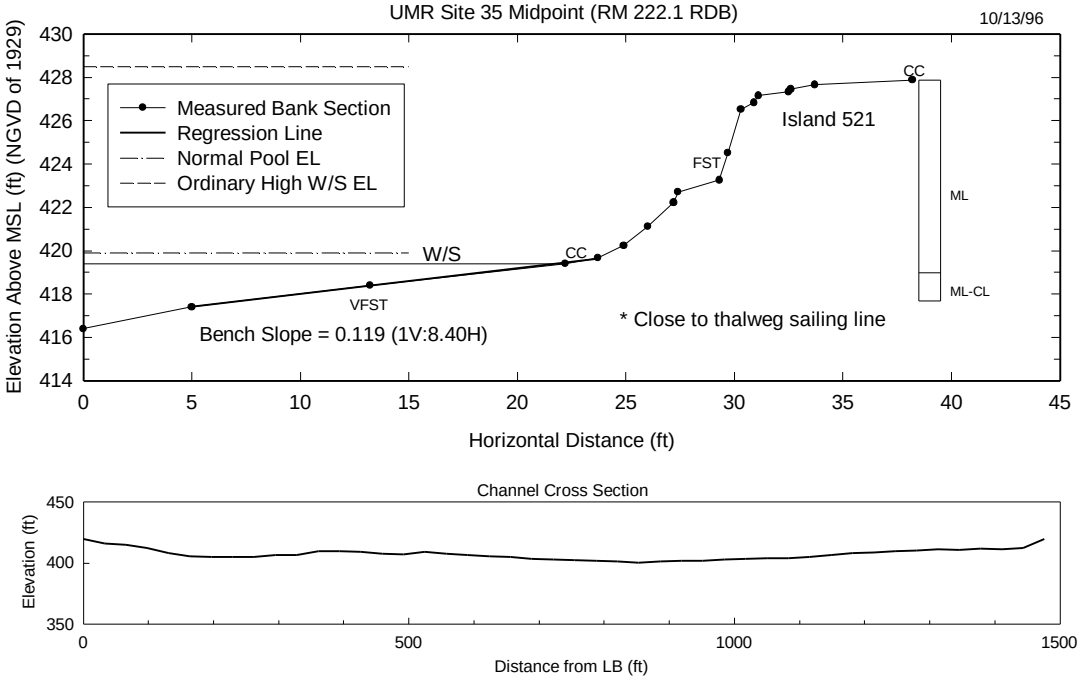

Figure 7-116 Bank section and channel cross section measured at Site 35 midpoint

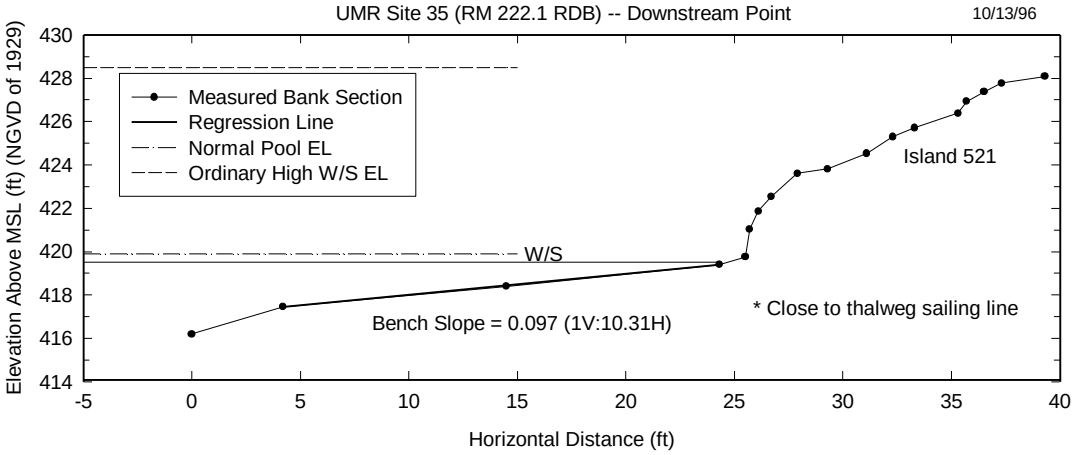

Figure 7-117 Bank section measured at Site 35 downstream point

The soil profile from one sampling tube core showed at least 9 ft of historical deposits. A poorly drained, fine grained, very late Holocene to historic surface lies below the recent historical sediment layers.

Causative factors for bank retreat at this site include flood-flow erosion and rapid recessional slumping, minor piping and collapse, and wave and rework-transport of failed soils and recently deposited sediments within bench areas. Because the site is very close to the thalweg sailing line, wave erosion within bench areas is more significant. Site 35 can be classified as Type A.

36. Site 36 at RM 217.5 RDB (Pool 26)

This right-bank site, shown in figure 7-118, is located along a rather straight reach, just 0.5 mile downstream from the confluence of the Illinois River, 14.6 miles upstream from Lock & Dam No. 26. Photo 7-87 shows a downstream view of the site, and Photo 7-88 shows a close-up view of the scarp. The bank section taken is shown in figure 7-119. The river cross section indicates that the site is located in the convex bank of a minor bend. At the top of the bank is a farm field, and some segments of a local road were found to be collapsing due to bank retreat. The bank soils consist of fine to medium silt (FST-MST) and fine sand (FS). Subaqueous sediments are fine sand (FS).

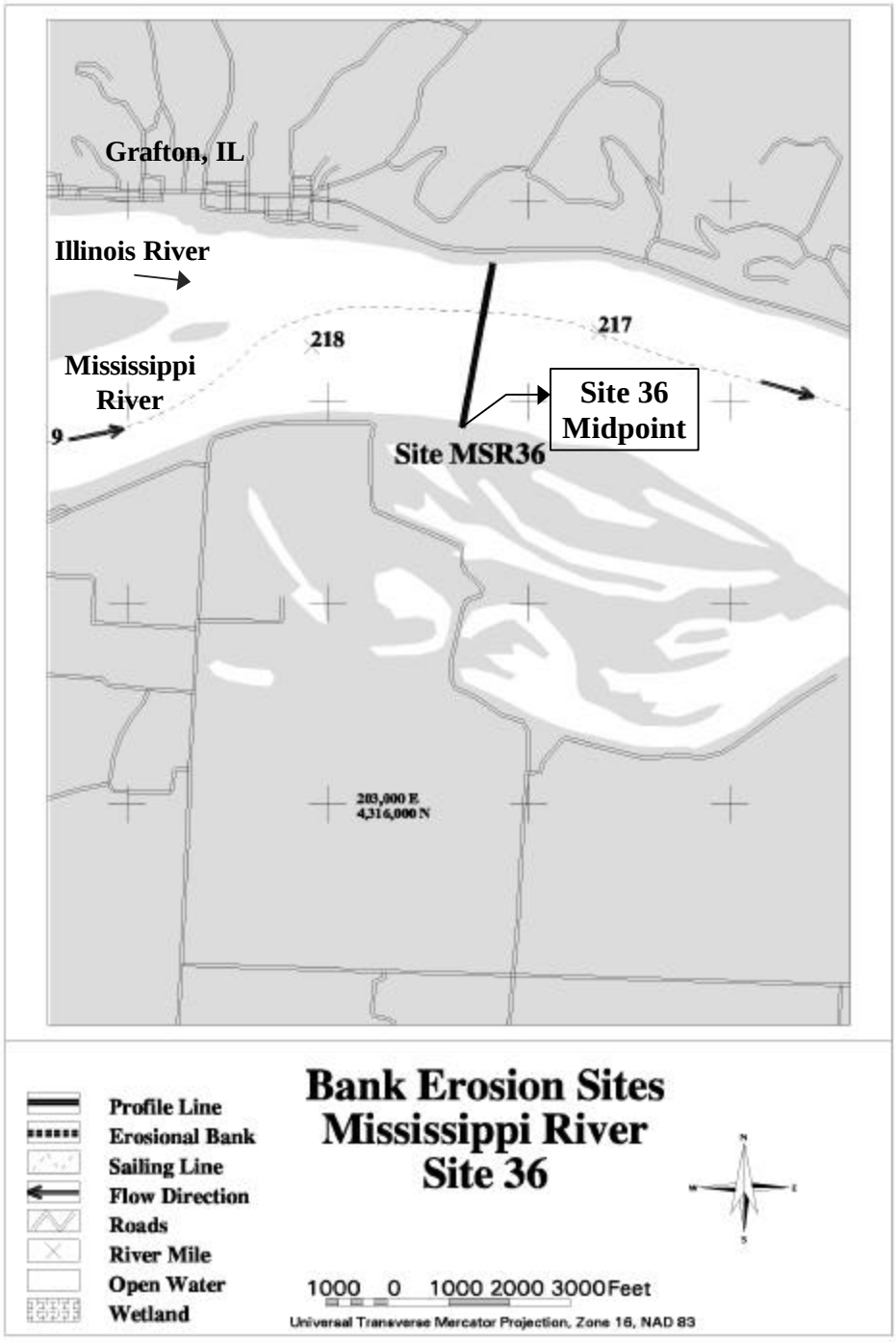

Figure 7-118 A map showing Mississippi River Site 36

Photo 7-87 A downstream view of Site 36 midpoint

Photo 7-88 A close-up view of scarp of Site 36 midpoint

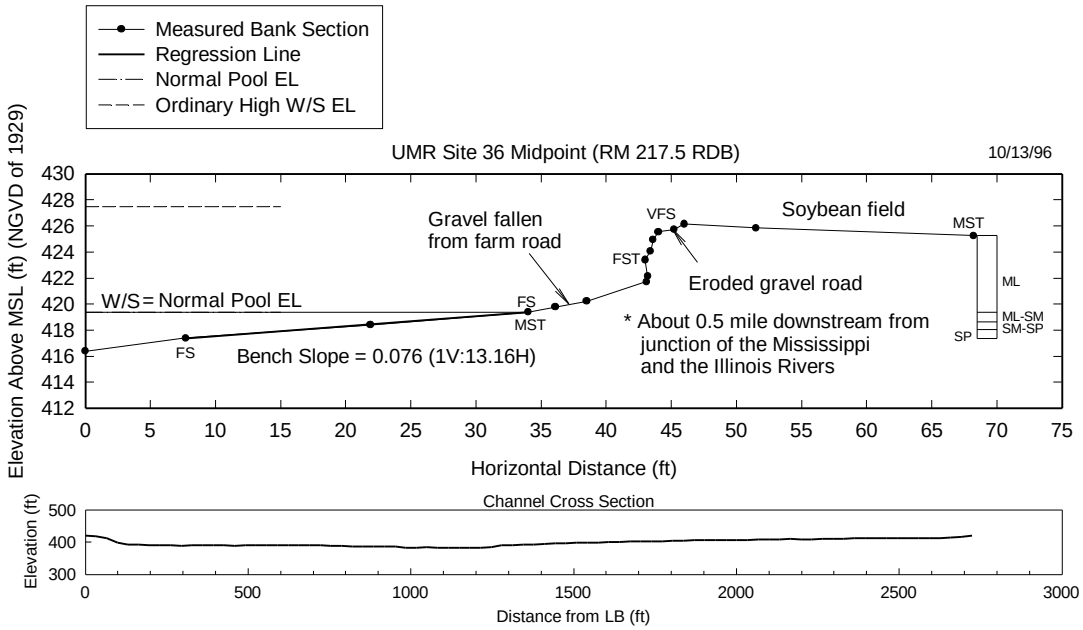

Figure 7-119 Bank section and channel cross section measured at Site 36 midpoint

Several minor overflow channels were found in the vicinity of the site. The relative ages of the landscape assemblages are probably late Holocene. Recent work conducted by Anderson at a nearby location showed Mississippi River alluvium, estimated to be 4,000 years old, buried by younger Illinois River alluvium (Titus et al. 1996). However, the one sampling tube core advanced at Site 36 encountered historical alluvium. The recent deposits are thickly and thinly bedded silt, clayey silt, and very fine sand, and they extend to at least 8 ft below the surface. Erosion at this site has removed historical alluvium.

Causative factors for bank retreat at this site include flood-flow erosion and recessional block failures, piping and collapse, slaking, overland drainage, and wave and seepage rework and transport of failed and slaked soils and recently deposited sediments within bench areas. Because the thalweg sailing line is far from the site, traffic-generated wave erosion appear to be minor. Type C can best describe Site 36.

36a. Observation Site at RM 200.2 RDB (Pool 27)

This observation site is near the tip of Maple Island, 2.7 miles downstream from Lock & Dam No. 26, and exhibits evidence of typical bank retreat caused by overland

Photo 7-89 A side view of Observation Site at RM 200.2 RDB

Photo 7-90 A close-up view of Observation Site at RM 200.2 RDB

drainage. Bank-line incisions (gullies) cut by overland drainage and seepage can be seen in Photo 7-89. Photo 7-90 shows a close-up view of the scarp, which exhibits many features, including slaking, gully formation, vertical cracking, flood-flow related erosional oversteepening and recessional slumping, and piping and collapse. The bank soil was primarily silt and clay.

37. Site 37 at RM 197.6 RDB (Pool 27)

This right-bank site on the inside of a sharp bend, shown in figure 7-120, is located less than 3 miles upstream from the Missouri River confluence at RM 195. Bank retreat since 1984 is evident in figure 7-120. Photos 7-91 and 7-92 show upstream and close-up views of the site, respectively. The bank section taken is shown in figure 7-121. The river cross section in figure 7-121 shows topography representative of the sharp bend along the site. The bank soils are primarily silt. The site is far from the thalweg sailing line. There is a barge-mooring site immediately downstream from the erosion site. There are several scarps within the bank. The levee along Mobile Island was overtopped during the Great Flood of '93, and this site is located where a breached portion of the levee was being repaired.

Soils in the area probably developed in the late Holocene. Missouri River alluvial fan deposits probably interfingered with Missouri River alluvium. The one sampling tube core advanced at the site showed a 6.0 ft profile composed entirely of thickly bedded historical alluvium and fill material.

As at Site 36, causative factors for bank retreat at this site include flood-flow erosion and recessional failures, piping and collapse, slaking, overland flows, and wave and rework transport of failed soils and recently deposited sediments in bench areas. Due to nearby fleeting activities, more extensive wave erosion occurs at this site. Type C best characterizes Site 37.

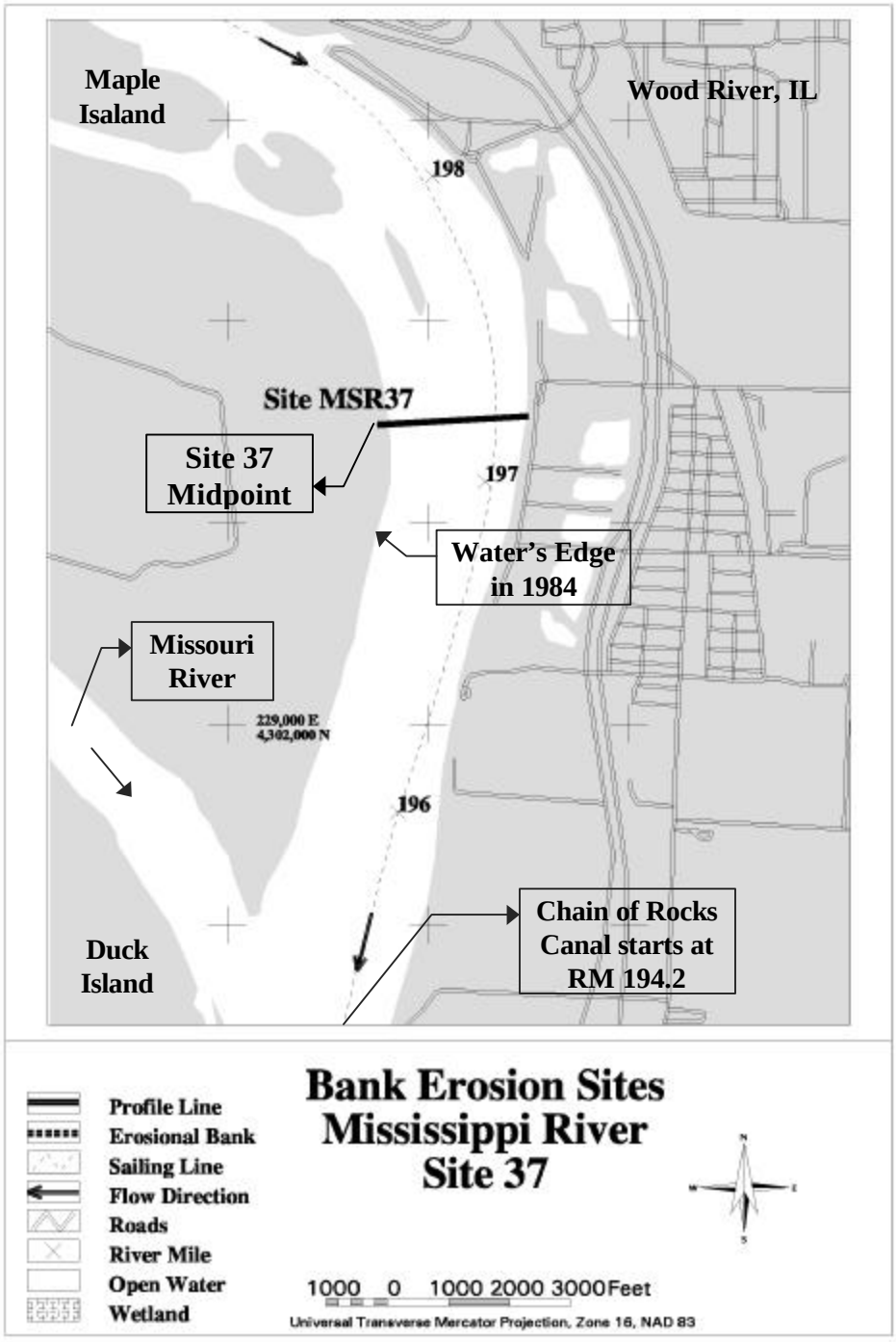

Figure 7-120 A map showing Mississippi River Site 37

Photo 7-91 An upstream view of Site 37 midpoint

Photo 7-92 A close-up view of Site 37 midpoint

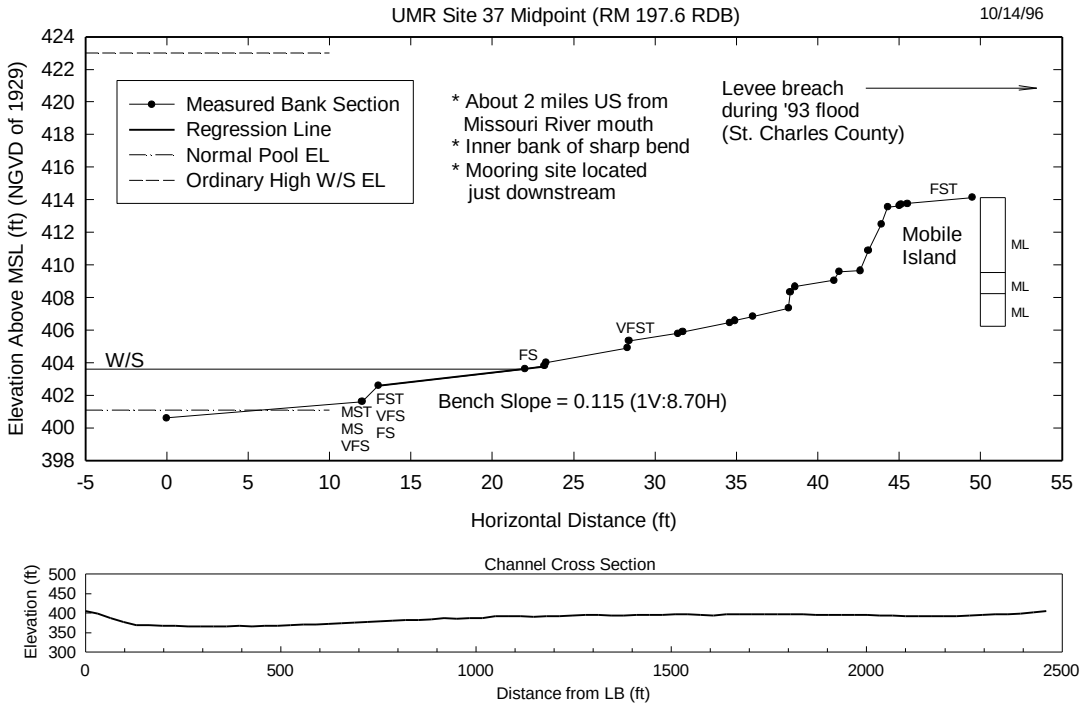

Figure 7-121 Bank section and channel cross section measured at Site 37 midpoint

37a. Observation Site at RM 195.1 LDB (Pool 27)

This left-bank observation site is located immediately upstream from the mouth of the Oahokia Creek diversion channel, and directly opposite the confluence of the Missouri River. The scarp exposes silty clay and clayey silt layers and is about 4 ft to 6 ft high. Historical deposits can be seen clearly in Photos 7-93 and 7-94. A dark-color native soil at the bottom of the scarp, as well as vertical cracks and fallen soil blocks, can be seen in these photos. At this site, a simple field experiment was conducted to demonstrate how fast a block of failed bank soil would disintegrate in water. A block of soil, about 4 in. high, 4 in. wide, and 8 in. long, was carefully placed in water, as shown in Photo 7-95. Only the bottom portion, about 1 in., was wet initially; however, the block disintegrated as soon as it was wetted. The process of this block disintegration is illustrated by Photos 7-96 through 7-98. Within 3 minutes, the entire block disintegrated. These photos are extremely important in describing the unique characteristics of failed soil blocks and peds which cannot resist wetting and slaking. Wetting destroys capillary

Photo 7-93 An upstream view of Observation Site at RM 195.1 LDB

Photo 7-94 A downstream view of Observation Site at RM 195.1 LDB

Photo 7-95 A block of failed bank soil placed in water (t = 0) -- Observation Site at RM 195.1 LDB

Photo 7-96 A block of failed bank soil placed in water (t = 1 min.) -- Observation Site at RM 195.1 LDB

Photo 7-97 A block of failed bank soil placed in water (t = 2 min.) -- Observation Site at RM 195.1 LDB

Photo 7-98 A block of failed bank soil placed in water (t = 3 min.) -- Observation Site at RM 195.1 LDB

action in fissures between peds, and the block disintegrates into individual fissure-defined pieces (peds). Any banks composed of unsaturated soils would be susceptible to wet/dry slaking. This observation site was eroded severely during the Great Flood of '93 and possibly during the flood of 1994 and the flood of 1995. The site demonstrates typical characteristics of bench area rework and transport described earlier. This erosion site can be classified as Type A.

This Observation Site at RM 195.1 LDB was the last study site within the lock and dam system of the Mississippi River. Other sites described below (Site 38 - Site 44) were located in the open-water river reach.

38. Site 38 at RM 175.2 LDB (Open Water)

There are no "***Normal Pool Elevations***" or "***Ordinary High Water-Surface Elevations***" defined for the open-water reach within the COE-St. Louis District. Comparable levels for the open-water study reach are represented by water-surface elevations which correspond to those for the mean discharge and for a discharge that is 125 percent of the mean discharge, respectively.

This left-bank site, shown in figure 7-122, is located within a busy fleeting area along a straight reach near St. Louis, Missouri. As can be seen in figure 7-122, the bank appears to have retreated considerably since the current navigation chart, based on the 1984 COE aerial survey, was published in 1989. Photos 7-99 and 7-100 show upstream and close-up views of the site, respectively. Photo 7-101 shows an upstream view of the bench, and Photo 7-102 shows a close-up view of wave attack on the lower bank which consists of recently deposited sand. Only one bank section was taken at this severely eroded bank site, which is shown in figure 7-123. The bank soils are primarily MST and FS. There were three distinct scarps with extensive piping features, as shown in figure 7-123. At the top of the bank is a farm field covered by two large sand dunes, 2 to 3 ft high and about 200 ft wide. The first row of dunes was located along the edge of the bank, and the second was located about 1,000 ft from the bank line. Both dunes were oriented parallel to the bank line. This silty sand deposition and dune formation is believed to have been produced by the Great Flood of '93 and subsequent floods of 1994 and/or 1995. Fine

sand was observed blown by strong winds. Numerous failed soil blocks were observed on the bank below the head scarp, as indicated in figure 7-123.

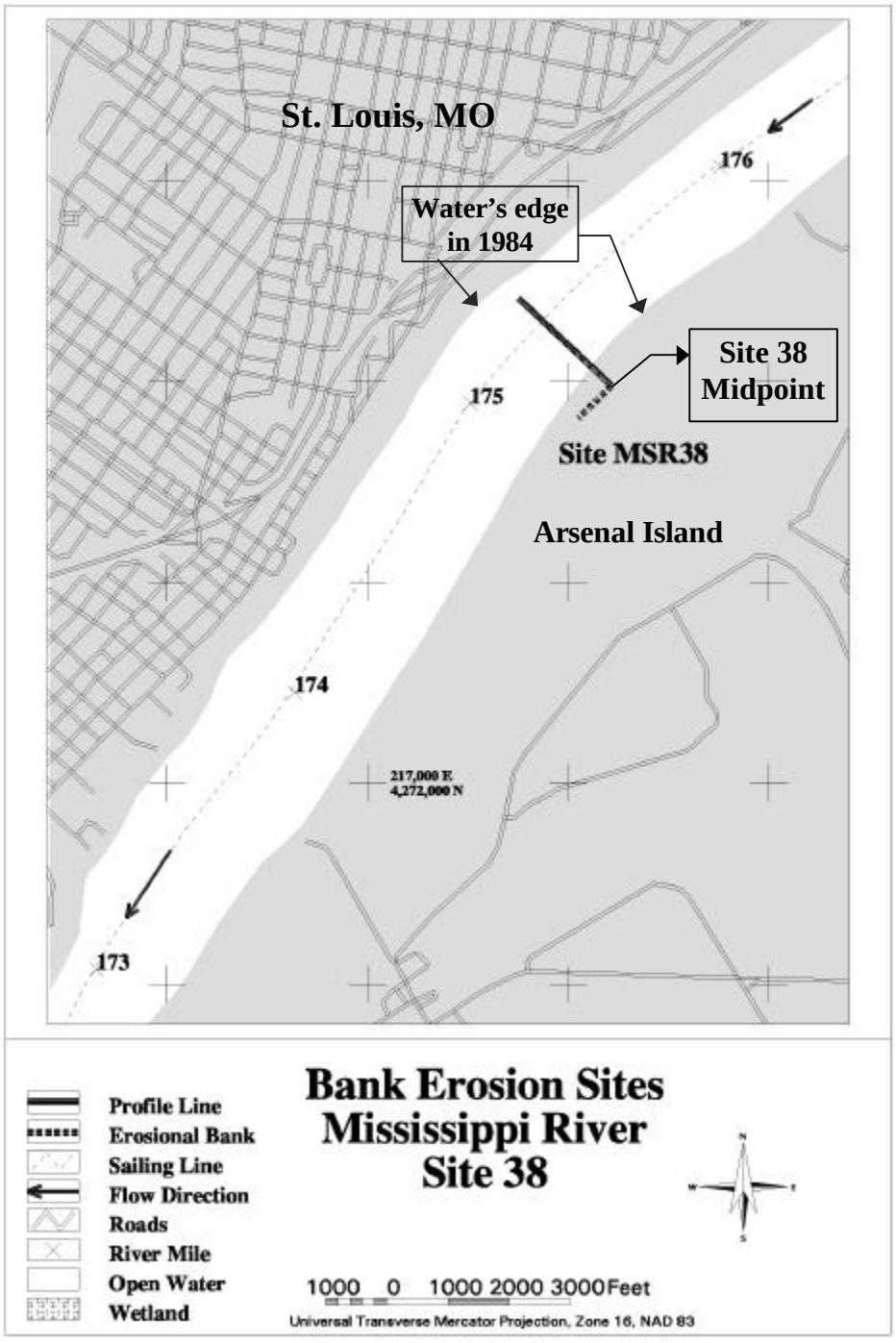

Figure 7-122 A map showing Mississippi River Site 38

Photo 7-99 An upstream view of Site 38 midpoint

Photo 7-100 A close-up view of Site 38 midpoint

Photo 7-101 An upstream view of bench of Site 38 midpoint

Photo 7-102 A close-up view of wave erosion at Site 38 midpoint

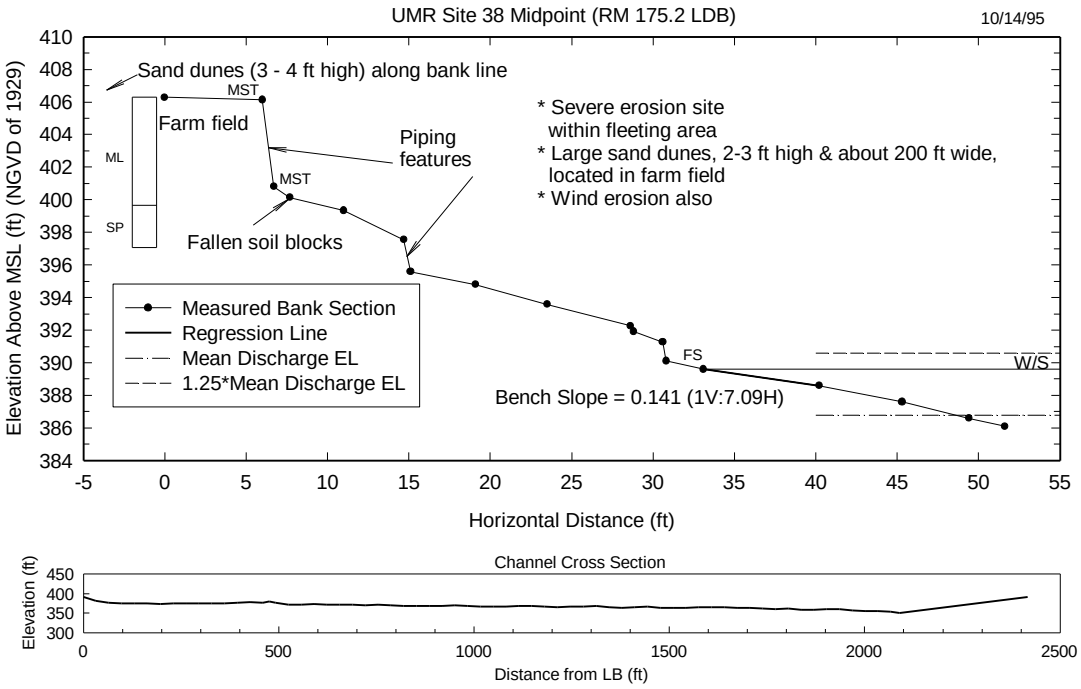

Figure 7-123 Bank section and channel cross section measured at Site 38 midpoint

Site 38 is located on what may be a deeply buried late Holocene surface. Recent historical deposits are extremely thick at this site and native soils were not observed. The thickly bedded historical silt and very fine sand laminae extend to about 6.6 ft, below which lies well-sorted, fine to medium sand which may be dredged spoil. Other observations at this location show what appears to be a recent (1993, 1994, and/or 1995) coarse-grained flood deposit which contained buried leaf litter.

Causative factors for bank retreat at this site include flood-flow erosion and recession and piping failures, slaking, wave and rework-transport of failed soil peds and recently deposited silty fine sand, and aeolian deflation. Barge fleeting-related wave erosion occurs within the bench area at this site. A combination of bank Types A, B, and C describes Site 38.

38a. Observation Site at RM 168.5 LDB (Open Water)

This left-bank observation site is located about 0.1 mile downstream from the Jefferson Barracks Highway Bridge. These banks, containing two vertical scarps, approximately 6 ft high, are located immediately downstream from an L-shaped rock-

Photo 7-103 An upstream view of Observation Site at RM 168.5 LDB

Photo 7-104 A downstream view of Observation Site at RM 168.5 LDB

Photo 7-105 A close-up view of Observation Site at RM 168.5 LDB

Photo 7-106 Sand lens found at terrace of Observation Site at RM 168.5 LDB

filled flow-training structure. As shown in Photos 7-103 through 7-105, multiple layers of historical deposits consisting of silty clay and clayey silt are exposed within each scarp. There was a sand lens, about 3-in. thick at the bottom of each scarp. These lenses are shown in Photo 7-106. This site is characterized by Type B. It should be noted that many bank-erosion sites within the open-water reach were located immediately downstream from rock-filled flow-training structures.

39. Site 39 at RM 112.4 LDB (Open Water)

This left-bank site, shown in figure 7-124, is located inside a bend on a small island. Photos 7-107 and 7-108 show upstream and downstream views of the site, respectively. Photo 7-109 shows eroded bank near the tip of the island and Photo 7-110 shows a close-up view of eroded bench. Although the site map does not show this bank to be on an island, erosion along the left bank at about RM 112.5 had formed a small island. The back channel of this island meets the MR at around RM 111.6. There are several large wing dams, and this erosion site is located between two wing dams. Around the upstream tip of the island, flow velocities toward the back channel were estimated to be about 8 ft/s. These flows are eroding the island. This erosion along the concave bank was initiated by the Great Flood of '93. The back channel apparently was eroded deeply during the flood, creating a large differential head between the main MR channel and the slough.

A wing dam and a large sand bar, located just upstream from the island tip, exacerbates island erosion by creating additional differential head where it diverts the MR flow toward the slough. The sand bar upstream of the island appeared to act as a dam to produce differential head. As shown in figure 7-125, multiple scarps with piping features were present with failed soil blocks. The total height of scarps was almost equal to the bank height, about 20 ft, and the bank soils are primarily medium silt (MST) and fine sand (FS). Subaqueous bed sediments consist of fine sand (FS).

Site 39 is located on an erosional bank composed of historical alluvium. A sampling tube core and bank exposure were examined. The native soil was not observed, but it is of Holocene age. A "Purex" brand plastic bottle was recovered from a steep scarp exposure

about 20.5 ft below the top of bank. The plastic bottle indicates that historical deposits are much greater than 20 ft thick at this location.

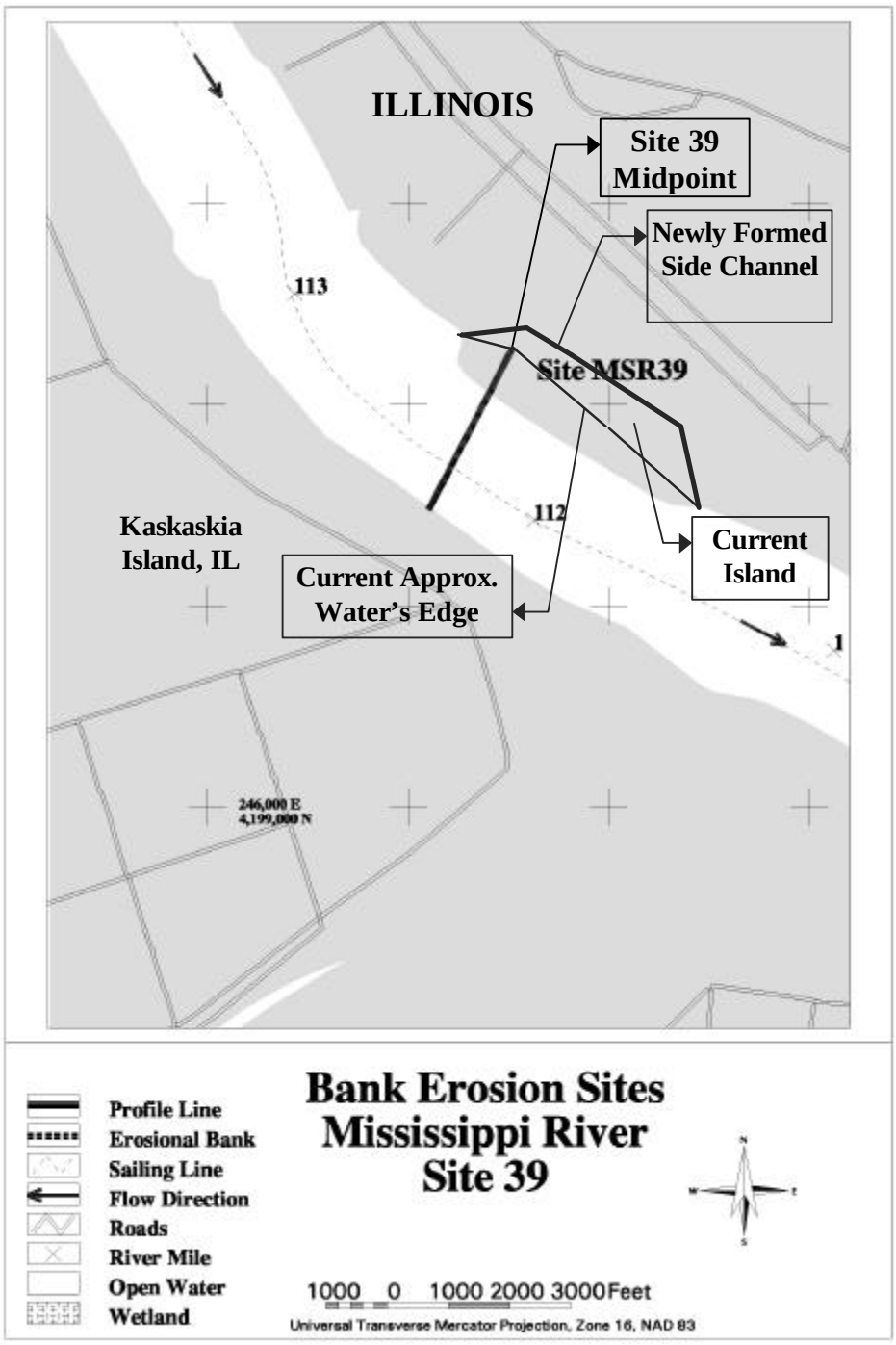

Figure 7-124 A map showing Mississippi River Site 39

Photo 7-107 An upstream view of Site 39 midpoint

Photo 7-108 A downstream view of Site 39 midpoint

Photo 7-109 An upstream view of the tip of island at Site 39

Photo 7-110 A close-up view of eroded bench at Site 39 midpoint

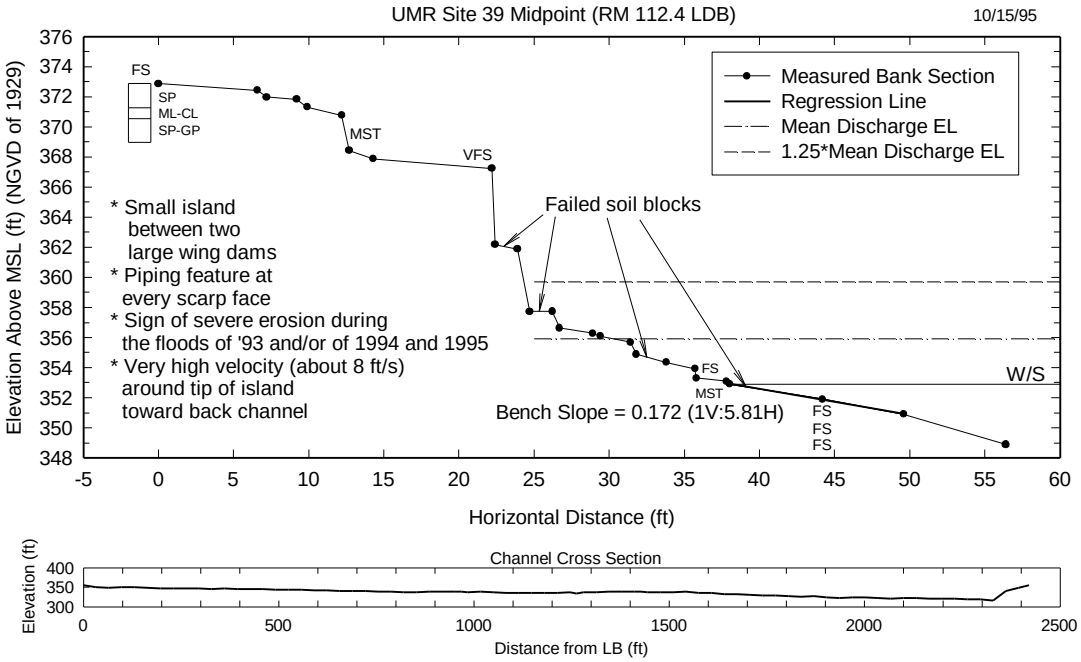

Figure 7-125 Bank section and channel cross section measured at Site 39 midpoint

Causative factors for bank retreat at this site include flood-flow erosion, impacts by flow-control structures, piping and failures, and wave and rework-transport of failed soils and recently deposited sediments within berm and bench areas. Although the thalweg sailing line is far from this site, silty sand deposits are eroded by waves. A combination of Types A, B, and C characterizes Site 39.

40. Site 40 at RM 94.1 RDB (Open Water)

This right-bank site on the outside of a sharp bend, shown in figure 7-126, is located immediately downstream from a small tributary outlet. Figure 7-126 shows that bank retreat had occurred since 1984 when the land coverage data for the current navigation chart were obtained. Photos 7-111 and 7-112 show upstream and downstream views of the site, respectively. Photo 7-113 shows a close-up view of eroded bench. Two bank sections were taken at this site, as shown in figures 7-127 and 7-128. There was no midpoint section at this site. Because the upstream section was located immediately